

Superconducting Magnetic Bearings for Space-Based Flywheel Energy Storage Systems, Phase I

Completed Technology Project (2011 - 2012)



Project Introduction

Balcones Technologies, LLC proposes to adapt technologies developed by and resident in The University of Texas at Austin Center for Electromechanics (CEM) in the areas of superconducting Trapped Field Magnet (TFM) motors, magnetic bearings, terrestrial and space-based flywheel energy storage systems, and air-core generators to address STTR 2010-1 Subtopic T3.01, Technologies for Space Power and Propulsion. In particular, our team will develop a concept design for high field intensity superconducting Trapped Field Magnetic Bearings (TFMB) for a space-based flywheel system, including magnetic field activation and cryogenic cooling subsystems. The design will focus on exploiting approximately \$47M of CEM technology to develop commercially viable superconducting magnetic bearings that significantly exceed the force density (developed force per unit of system mass) of today's magnetic bearings and will optimize the design for the space flywheel application rather than adapt terrestrial designs for space. Relevant features of our anticipated solution include:

- ✧ Much lower power usage than conventional non-superconducting magnetic bearings.
- ✧ Much stiffer magnetic bearings than conventional non-superconducting magnetic bearings.
- ✧ Much stiffer magnetic bearings than current superconducting magnetic bearing technology.
- ✧ Capable of high rotational speeds.
- ✧ Operation at magnetic fields of 2.5-3 Tesla to allow demonstration within a normal 24 month Phase II STTR, but with a design approach amenable to future systems at ~ 10 Tesla .
- ✧ Air-core magnetic circuit design (e.g., does not employ iron to guide magnetic fields which limits magnetic fields to 2 Tesla or less and practically limits operational fluxes to ~ 1 Tesla).
- ✧ TFM charging system to inject the magnetic field, most likely based on a system to cool the magnet while maintaining an applied charging field, but could also be a pulse charging system of a pre-cooled TFM.



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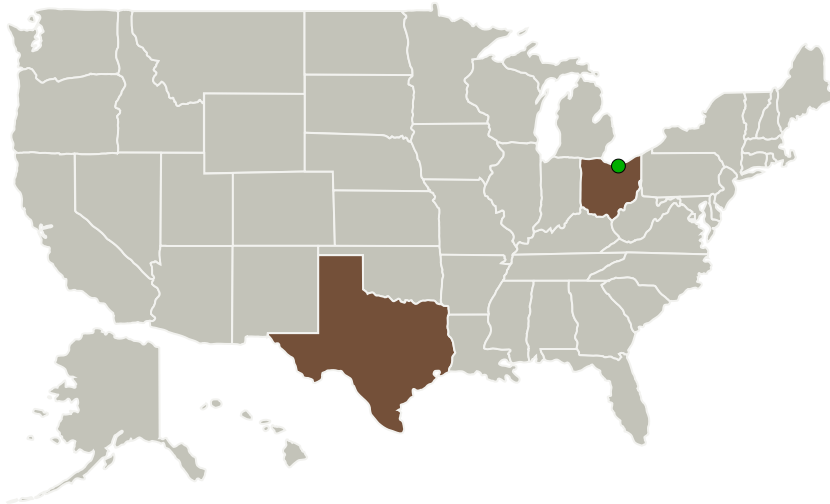
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Balcones Technologies, LLC	Lead Organization	Industry	Austin, Texas
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
The University of Texas at Austin	Supporting Organization	Academia	Austin, Texas
University of Texas - Center for Electromechanics	Supporting Organization	Academia	Austin, Texas

Primary U.S. Work Locations

Ohio	Texas
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Project Transitions

▶ **February 2011:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Balcones Technologies, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Joseph H Beno

Co-Investigator:

Joseph Beno

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February 2012: Closed out

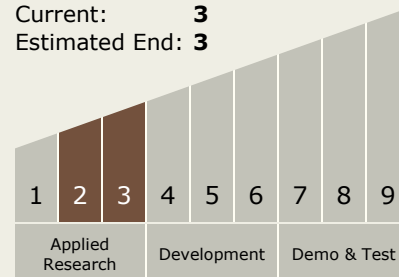
Closeout Summary: Superconducting Magnetic Bearings for Space-Based Flywheel Energy Storage Systems, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image(<https://techport.nasa.gov/file/138584>)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
 - TX03.2 Energy Storage
 - TX03.2.3 Advanced Concepts for Energy Storage

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System